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6. AUTHOR(S)
Richard W. Sternberg
Erika E. McPhee

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
School of Oceanography
University of Washington
Box 357940
Seattle, WA 98195-7940

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14. ABSTRACT This was a two-part study to investigate mechanisms for generating intermediate nepheloid layers (INLs) on continental slopes. The first part was a laboratory experiment that generated internal waves on a sloping bed in a stratified fluid which produced INLs. The second part applied the physical understanding gained from the laboratory results to analyze field data collected from the Northern California continental slope as part of the STRATAFORM project. Field data showed that INLs were often associated with regions of critical slope topography where internal wave reflection is common, suggesting that internal waves may be responsible for the generation of slope INLs.

15. SUBJECT TERMS
continental slopes, internal waves, intermediate nepheloid layers

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ORIGINS OF NEPHELOID LAYERS ON CONTINENTAL SLOPES: LABORATORY AND FIELD EXPERIMENTATION

Richard W. Sternberg
Erika E. McPhee
(Dissertation Advisor: A.R.M. Nowell)
School of Oceanography, Box 357940
University of Washington
Seattle, WA 98195-7940
phone: (206) 543-0589 fax: (206) 543-0275 email: rws@ocean.washington.edu
http://www.ocean.washington.edu
Award #N00014-97-1-1011

RESULTS

When internal waves reflect from a sloping boundary, turbulence and mixing are strongest when the angle of the internal-wave beam is the same as that of the sloping boundary. In the laboratory, mixing of stratified fluid causes intrusions to spread away from the boundary. It is proposed that this process might occur along ocean margins and could be the mechanism by which intermediate nepheloid layers detach and spread seaward from a continental slope.

Laboratory experiments were used to investigate the growth of intrusions due to internal waves reflecting from a sloping boundary. When normalized by the incident energy-density-flux, the average intrusion velocity was found to be a linear function of the parameter ω/ω_c. Evenly spaced layers, indicating thin perturbations in the background density gradient, developed within the mixing region and spread into the tank interior. The vertical spacing between these layers bore a linear relationship to ω/ω_c, and a linear model of internal-wave reflection suggests that these layers may be related to an isopycnal displacement, overturn, scale. Intrusion growth occurred at a range around the critical frequency, and was strongest at slightly supercritical ($\omega/\omega_c > 1$) conditions. A balance between the divergence of energy-density-flux and change in potential energy was suggested to describe the growth of intrusions. Fitting the laboratory results to this theoretical prediction suggested a low net buoyancy flux. The equation for intrusion growth can be used to predict spreading rates for INLs at ocean margins. CTD and transmissometer surveys over the northern California margin showed that INLs could be classified as either shelf INLs, generated between 60 and 200-m depth, or slope INLs, which detached from the continental slope at depths greater than 200 meters. Both shelf and slope INLs were often associated with regions of critical topography. Shelf INLs were strongest in winter, suggesting that their generation is tied to the supply of sediment from winter wave resuspension or Eel River floods. Mooring data suggest that internal-wave reflection is common on this continental slope. Internal-wave reflection occurred in intermittent pulses and may be responsible for the generation of slope INLs at the Eel River margin.

PUBLICATIONS

McPhee, E.E. and D.A. Cacchione (1998) Regional characteristics of suspended sediments at intermediate slope depths on the Northern California continental slope. Talk presented at AGU Fall Meeting, San Francisco, CA.

McPhee, E.E. (2000) Laboratory experiments on internal-wave generation of boundary-layer intrusions and nepheloid layer detachment. Talk presented at AGU/ASLO Ocean Sciences Meeting, San Antonio, TX.

McPhee, E.E. (2000) Internal-wave mixing along sloping boundaries: A mechanism for generating intermediate nepheloid layers. Doctoral dissertation, University of Washington, Seattle, WA.